

The Ordovician–Silurian boundary in the Oslo region, Norway

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Synopsis

The Ordovician–Silurian boundary is exposed sporadically throughout the southern and central parts of the Oslo region; to the north there is an unconformity. In the central Oslo–Asker districts a well-developed *Hirnantia* fauna underlies beds with *acuminatus* Zone graptolites; other beds yield *Holorhynchus* faunas in the late Ordovician and early members of the *Stricklandia* lineage in the overlying Llandovery. Some early Silurian conodonts and acritarchs are recorded.

Lower Palaeozoic rocks outcrop in the Oslo region within a 230 km by 50 km area which is separated from the Precambrian to the east by the faults of a Permian graben. Within this broad region, most recent work in the late Ordovician and early Silurian has been achieved in the Oslo–Asker district, which lies in the approximate centre of the region, and also in the Hadeland district, some 50 km to the north of Oslo. These and other districts will be reviewed in turn. The Ordovician and Silurian beds in the area have been known since the early work of Murchison, Kjerulf, Broegger and others, and were the subject of a monumental study near the turn of the century by Kjaer (e.g. 1908). During the past fifteen years much new work has been done, for example Worsley *et al.* (1983) proposed a modern system of stratigraphical nomenclature for the Silurian rocks of the region.

Oslo–Asker District. The formation names for the late Ordovician stratigraphy (Fig. 1) were erected by Brenchley & Newall (1975), and its biostratigraphy and ecology elucidated by Brenchley & Cocks (1982), its trilobites described by Owen (1980, 1981) and its brachiopods by Cocks (1982). The topmost few metres of the Husbergøya Shale carries the trilobite *Tretaspis sortita broeggeri*, which Owen (1980) regarded as indicative of the uppermost Rawtheyan Stage. A *Hirnantia* fauna is known from horizons near the base of the Langøyene Sandstone Formation and within the Langåra Limestone–Shale Formation (Brenchley & Cocks 1982: 796), and includes common *Dalmanella testudinaria*, *Hirnantia sagittifera*, *Cliftonia* aff. *psittacina*, *Hindella cassidea*, *Eostropheodonta hirnantensis*, *Mucronaspis mucronata kjaeri*, bryozoans and crinoid stems, and less common *Acanthocrania*, *Glyptorthis*, *Lingula*, *Leptaena*, *Orbiculoidea*, *Oxoplecia*, *Philhedra*, *Calyptaulax*, *Illaenus*, *Platycoryphe*, *Toxochasmops*, molluscs, crinoids and carpoids. Elements of the *Hirnantia* fauna persist above this horizon in *Hindella*–*Cliftonia* and *Dalmanella* associations higher in the Langøyene Sandstone and there are also other faunas there such as one dominated by *Trematis norvegica* and modioloisid bivalves. Above these, in the west of the area in Asker there occur thick beds largely composed of *Holorhynchus giganteus*, but with 13 other brachiopods and 17 other animals also recorded from them (Brenchley & Cocks 1982: 802), whilst in the east of the area, in the Oslo District, only trace fossils occur in rocks believed to represent a shore-face environment. At the top of the Langøyene Sandstone there occur shallow-water channel sequences which in some cases bear high abundance, low diversity faunas dominated by brachiopods such as *Brevilamnulella kjerulfi* and *Thebesia scopulosa*. This total sequence represents a regression since at least mid-Rawtheyan times, but above the channel-fill beds there occurs a metre-thick couplet of sandstone and limestone over the whole district which carries faunas, which are not age-diagnostic, of small shells such as *Onniella*, *Eoplectodonta*, *Leangella*, *Paucicrura* and *Dolerorthis*, as well as crinoids and bryozoa (and 16 other rarer forms). This couplet is lithologically included within the Langøyene Formation, but in fact marks the start of the ‘early Silurian’ transgression in the area. It is conform-

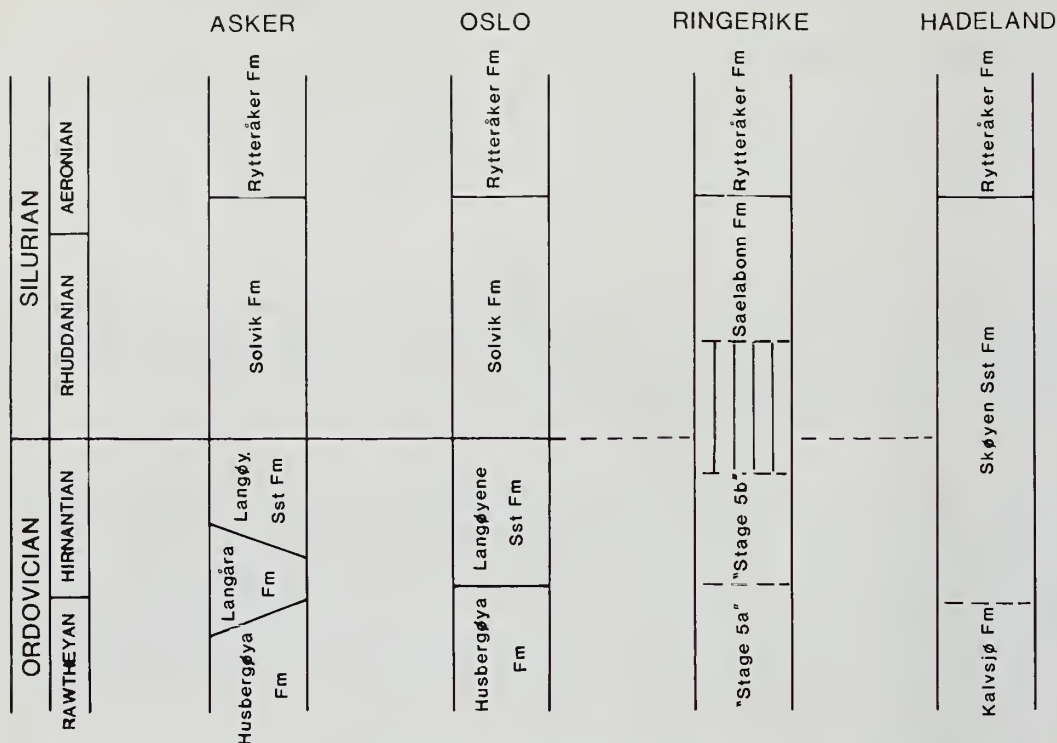


Fig. 1 Latest Ordovician and early Silurian stratigraphy in the Asker, Oslo, Ringerike and Hadeland districts of the Oslo Region.

ably followed by the basal organic-rich shales of the Solvik Formation in the Oslo District, which carries no shelly fauna, but from which Howe (1982) has identified *Climacograptus transgrediens* Waern from an horizon 11 m above the base of the formation at Ormøya, which he attributes to an horizon low in the *acuminatus* Zone (or perhaps high in the *persculptus* Zone). In the west of the area, in the Asker District, there was no break in the deposition of shelly faunas, and brachiopods are recorded from all three members of the Solvik Formation there, in a similar way to the higher parts of the formation in the Oslo District (Baarli 1985; Baarli & Harper 1986). The first occurrence of *Stricklandia lens prima* is at 95 m above the base of the Solvik Formation (Myren Member) and the transition from *S. lens prima* to *S. lens lens* occurs between 122 and 130 m above the base (Baarli 1986). Conodonts of the *Icriodella discreta-I. deflecta* Zone are known from 8 m above the base of the Solvik Formation at Konglungen, Asker (Aldridge & Mohamed 1982). Above the three members of the Solvik Formation, the Rytteråker Formation yields pentamerides and conodonts of Aeronian age: Nakrem (1986) has identified the *Distomodus kentuckyensis-D. staurognathoides* conodont zonal boundary as occurring at about the boundary of the Solvik and Rytteråker Formations.

The Ringerike area. The latest Ordovician of the Ringerike area remains unrevised, and thus the old stage terminology of Kiaer (1897, 1908) is employed—it carries a rich brachiopod fauna, but one not identical to that from the Oslo-Asker region and no *Hirnantia* fauna is known from the area; it also differs in the presence of bioherms and patch reefs within Stage 5b, the most notable of which is at Ullerntangen. The relationships between the Ordovician and Silurian beds are obscure and a local unconformity is postulated here (Fig. 1). The overlying beds of the Saelabonn Formation are shallow-water storm deposits with lenses of displaced

shelly faunas (Thomsen 1982); their detailed age is indeterminate, but probably includes the Lower Llandovery. The overlying Rytteråker Formation includes the *Borealis–Pentamerus* transition near its base (Mørk 1981), and that horizon is certainly now in the Aeronian. Smelrør (1987) has identified the acritarch zones 1 and 2 of Hill (1974) as occurring in the Saelabonn Formation.

The Hadeland area. Owen (1978) has revised the late Ordovician and early Silurian of this area and established a Rawtheyan age for the Kjørrven Formation which underlies the Kalvsjø Formation, which carries a sparse trilobite fauna, some brachiopods and the cystoid *Hemicosmites* and the calcareous alga *Palaeoporella* which indicate an Ordovician rather than a Silurian age. Above this the 120 m thick Skøyen Sandstone Formation appears to straddle the Ordovician–Silurian boundary, since beds with *Zygospiraella* and other typical early Silurian brachiopods occur from about the middle of the formation. The Skøyen Sandstone is succeeded conformably by the Rytteråker Formation which yields *Borealis borealis* near its base.

Other areas. From the Skien and Porsgrunn district near the south of the Oslo Region, for example in a section at Herøyavegen, Porsgrunn, *Holorhynchus* beds followed by early Silurian beds yielding *Zygospiraella duboisi* (Verneuil) and *Eostropheodonta mullochensis* (Reed) are known, but the stratigraphy is unrevised. In the Oslo region north of Hadeland there is an unconformity between the late Caradoc and early Ashgill Mjøesa Limestone and the early Silurian, for example Møller (1986) has described the succession at Brummunddal, where the Helgøya Quartzite of probable Aeronian age bearing *Borealis borealis* rests on the Mjøesa Limestone.

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